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Citation for published version:

Bak, T 2016, 'Cooking pasta in La Paz: Bilingualism, bias and the replication crisis', *Linguistic Approaches to Bilingualism*, vol. 6, no. 5, pp. 699-717. <https://doi.org/10.1075/lab.16002.bak>

Digital Object Identifier (DOI):

[10.1075/lab.16002.bak](https://doi.org/10.1075/lab.16002.bak)

Link:

[Link to publication record in Edinburgh Research Explorer](#)

Document Version:

Peer reviewed version

Published In:

Linguistic Approaches to Bilingualism

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Cooking Pasta in La Paz:
Bilingualism, Bias and the Replication Crisis

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Submission to the special issue of “*Linguistic Approaches to Bilingualism*” on “*Bilingualism and Executive Functions*”

Keywords: bilingualism, replication, bias

Version approved 13 April 2016

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Abstract

Literature on bilingualism and cognition is characterised by a large amount of conflicting evidence. In some studies, bilinguals perform better than monolinguals on executive tasks involving inhibition, monitoring and switching but are slower on tasks of lexical processing. Other studies don't find any significant effects and challenge the very existence of cognitive differences between monolinguals and bilinguals. In this paper I question the assumption that different studies performed in different parts of the world should yield the same results. I argue that the environment (in the widest sense of the word) in which an experiment is conducted can exert profound influence on its outcome. Against the background of the current debate about the replication crisis in science I propose that conflicting evidence is not a threat to the trustworthiness of scientific research but a sign of the health of a discipline and a welcome opportunity to identify new relevant variables.

1. Controversy, conspiracy or consensus?

At first sight, the question whether bilingualism is associated with cognitive benefits, particularly in the area of executive functions is a topic of an intense controversy. The evidence so far is inconsistent. On one hand, a large number of studies show better cognitive functions in bilingual children (Kovács & Mehler, 2009), young adults (Bak, Vega-Mendoza, & Sorace, 2014; Vega-Mendoza, West, Sorace, & Bak, 2015) and elderly (Bak, Nissan, Allerhand, & Deary, 2014; Kavé, Eyal, Shorek, & Cohen-Mansfield, 2008). These findings have been linked to evidence from structural and functional neuroimaging (Abutalebi et al., 2013; Gold, Kim, Johnson, Kryscio, & Smith, 2013). Moreover, a potential clinical relevance of these differences is underlined by studies reporting a bilingual delay in the onset of dementia (Alladi et al., 2013; Bialystok, Craik, & Freedman, 2007; Woumans et al., 2015) and a better cognitive outcome after stroke (Alladi et al., 2015). On the other hand, many of these findings have been called into question, including results in children (Duñabeitia et al., 2014), young adults (Paap & Greenberg, 2013) and in dementia (Zahodne, Schofield, Farrell, Stern, & Manly, 2014). New evidence seems to be growing constantly on both sides, unlikely to provide a satisfactory explanation for the discrepancy in findings. The stakes in this debate have been raised by the suggestion that bilingualism might have a more profound effect on dementia than any currently available drug treatment. With such a potential relevance for public health, any findings in this area need to be carefully scrutinised (Bak, 2016; Bialystok et al., 2016).

There are two main strategies with which this problem of conflicting evidence can be approached. The first one assumes that one side is right and, therefore, the other one must be necessarily wrong. Accordingly, either all the positive or all the negative results must be a product of bias, self-deception, unsound statistical analysis, faulty logic or some other type of error. Such an approach has much in common with the **adversarial style** dominating legal systems and political life in many countries. It has many advantages: it forces the opponents to formulate clear hypothesis, sharp arguments and convincing justifications. It focuses the debates on the most relevant points and can be more entertaining to readers, viewers and listeners than the sometimes rather dull consensus. However, in science, as in politics, the adversarial approach has also its downsides, often just the other side of what we could justly consider as its advantage. The focused nature of the arguments can mean a narrowing of the perspective, leaving out the sheer diversity of the phenomena in question. The confrontational nature of the debate offers a temptation to reduce the complexity of the matter to well-sounding but inadequate slogans. It pushes the adversaries towards a partisan myopia and “**selective scepticism**”, in which a detailed scrutiny of the other side is combined with an uncritical acceptance of everything that can be used in one’s favour. After all, one would not expect the prosecution to search for arguments that would strengthen the defence and vice versa. And once the arguments are exhausted, an adversarial debate risks shifting the emphasis from the relevant topics to the individuals representing them; taken to extremes it can lead to conspiracy theories.

An alternative approach is **constructive scepticism**. It is constructive in assuming that both positive and negative results are genuine, but reflect possible differences in experimental designs, definitions of the phenomena in question, examined populations and the environment in which the research is being conducted. As true scepticism, it critically examines the evidence and the arguments on **both** sides. It sees as its main objective not to prove one’s point but to try to understand and explain current puzzles and contradictions. It does not deny opposing points of view but tries to transcend them. It can build on a long tradition of dialectics, from Ancient Greece (and indeed Ancient India), through medieval universities up to the present day. In the dialectical method, the thesis and antithesis is followed by a synthesis, integrating both and, hopefully, coming closer to the truth.

Superficially, it is easy to get carried away by the colourful rhetoric of the current “bilingualism debate”. But looking below the surface, we might find a surprising amount of convergence. Admittedly, some studies show significant differences between mono- and bilingual groups and others don’t, but **if** there is a difference, it has a remarkably similar pattern across various studies. It is like a mountain chain submerged under water, hidden and exposed in turn by rising and falling tides but nevertheless maintaining its shape. The highest peak of this chain are executive functions; if a study comparing mono- and bilingualism finds only one difference between both groups, it is much more likely to be in the executive domain than in any other cognitive function, such as memory or visuospatial skills (Bak, Nissan, et al., 2014). Even within the executive functions, there is a recognisable profile. The executive functions most frequently reported to be modified by bilingualism are those connected with inhibition, monitoring and switching. In contrast, reasoning tasks such as Tower of London usually do not show any difference between the groups (de Bruin, Bak, & Della Sala, 2015).

The same **consistency of profile** applies to the negative effects of bilingualism. One of the best-established (although at first slightly counter-intuitive) findings in bilingualism is the observation of its detrimental effect on several linguistic measures such as lexical access (Gollan, Montoya, Fennema-Notestine, & Morris, 2005; Ivanova & Costa, 2008). A similar contrast between executive functions and language extends also into the studies of the effects of bilingualism on brain diseases. In stroke, bilingualism is associated with a better outcome in terms of post-stroke dementia and post-stroke mild cognitive impairment but **not** in terms of post-stroke aphasia (language disorder) (Alladi et al., 2015). Indeed, a similar pattern emerges even in papers cited usually as examples of null-results, reporting no differences between mono- and bilinguals. A large longitudinal study of the Hispanic population from the Washington Heights area of New York (Zahodne et al., 2014) found a better initial performance in bilinguals on all four cognitive composite scores they measured. However, the difference was biggest for the executive function score, followed by speed, language and memory. Can we explain satisfactorily such a consistent profile through random variation? Or can it lead us to the possible reason for the conflicting evidence? If we follow the metaphor of a submerged mountain chain, we can predict which parts are likely to appear first when the water levels begin to fall. The task is to identify what determines the changes in water level.

This paper argues that the conflicting evidence in the area of bilingualism and cognition and the ensuing debate are neither surprising, nor worrying, nor exceptional compared with other areas of science. I will focus on three areas. Firstly, I will examine some common myths, misconceptions and false dichotomies about bilingualism and cognition. By exaggerating or misinterpreting research results they naturally invite well-justified criticism. Secondly, I will place the current debate into a broader context of the “replication crisis” in modern science. Finally, I will attempt to address the fundamental question behind this debate: should we expect all studies to replicate, regardless of the environment in which they have been conducted? Or can the non-replications turn out to be a source of new insights and a motor of future scientific progress? Although my arguments will naturally revolve around bilingualism, I hope that they will be of some interest also to the topic of the “*replication crisis*” in general.

2. Are bilinguals better lovers? Myths, misconceptions and false dichotomies

The recent findings of bilingualism research have produced an extraordinary interest in the media. Newspapers, radio and television report extensively about studies exploring potential influence of bilingualism on cognitive functions across the lifespan and in brain disease. While the interest of general public in scientific discoveries is to be welcomed, it can lead to a simplification of complex findings to make them understandable to a broader readership or audience. This can easily produce exaggerations going

well beyond what is supported by evidence, as exemplified by the bold claim that “*People Who Are Bilingual Are Smart, Creative and Better Lovers*” (<http://elitedaily.com/life/culture/bilingual-people-smart-creative-lovers/1012727/>).

It would be tempting but inaccurate to put all the blame on the media; the tendency to exaggerate the potential relevance of research findings can be traced back to academic press releases (Sumner et al, 2014), if not to the statements by scientists themselves. The current emphasis on “*impact*” in an environment shaped by increasing competition means that many scientists and their institutions feel under pressure to produce constantly novel and socially relevant results: an atmosphere unlikely to encourage a balanced and self-critical attitude, which characterises the best of scientific endeavour. So it might be worth to start our considerations by discussing some common myths and misconceptions about bilingualism and cognition, wherever they might have originated.

(1) People are either monolingual or bilingual

For practical reasons, many if not most studies of bilingualism compare two groups: “*monolinguals*” and “*bilinguals*”. However, bilingualism is neither a dichotomous, “*categorical variable*” (Luk & Bialystok, 2013) nor a “*unitary phenomenon*” (Bak & Alladi, 2014). There can be different degrees of proficiency in bilingualism, from some knowledge of an additional language to a perfect mastery of both of them (Bialystok, in this volume). Even a relatively short exposure to a new language can lead to cognitive effects (Linck, Kroll, & Sunderman, 2009). The effects of proficiency can be further modulated by language use: in a recent study conducted in the Hebrides (de Bruin et al., 2015), the performance pattern of “*inactive bilinguals*”, who were fluent in both Gaelic and English but used only English in their every-day life was more similar to that of English-speaking monolinguals than to the active Gaelic/English bilinguals, using both languages regularly. Furthermore, it is also unclear whether bilingualism effects can be potentiated (or at least modulated) by knowledge of more than two languages (Freedman et al., 2014).

Another variable of potentially great importance is the age of acquisition. Traditionally, what was perceived as the classical case of bilingualism was early, simultaneous acquisition of two (or more) languages. However, several studies suggest that later acquisition of a language could also produce a cognitive effect, possibly a different one from that of early bilingualism (Bak, Vega-Mendoza, et al., 2014; Tao, Marzecová, Taft, Asanowicz, & Wodniecka, 2011). In fact, as suggested recently, learning a language later in life could have a more profound cognitive effect than the classical early acquisition, since it requires a “*reconfiguration*” of already existing cognitive skills leading to “*collateral cognitive improvements*” (Duñabeitia & Carreiras, 2015).

(2) Either all or nothing, either good or bad

This is possibly the most common source of misunderstandings, often leading to others. For most of the 20th Century bilingualism was seen as a negative phenomenon, damaging intelligence and well-being (Saer, 1922). Once this myth had been dispelled, the pendulum seems to have gone the other way, with bilingualism being associated with all conceivable benefits (see the “*better lover*” claim above). It is important to stress that this is not the attitude of leading bilingualism researchers, who emphasise that bilingualism can influence some cognitive functions positively, other negatively and other not at all (Bialystok, 2009; Bialystok & Feng, 2009; Gollan et al., 2005; Ivanova & Costa, 2008; Linck et al., 2009).

One of the more recent manifestations of the “*all or nothing*” principle is the tendency to count how many cognitive functions were influenced by bilingualism in individual reports and then declare the winner (Paap, Johnson, & Sawi, 2015). Such an approach neglects not only all kind of differences among the studies but misses the fact, that many studies include specific cognitive functions exactly because they are **not** expected to vary between mono- and bilinguals, e.g. two-modalities dual task (Bak, Vega-Mendoza, et al., 2014) or reasoning tasks (Bak, Nissan, et al., 2014; de Bruin et al., 2015). Hence, a characteristic pattern of results, limited to specific cognitive functions and not others is an argument for rather than against the impact of bilingualism on cognition.

(3) Bilingualism prevents dementia

This misconception could be seen as a special case of the preceding one, but given the importance attached to the “health argument” in recent years it merits a separate discussion. The most commonly used incorrect formulation is that “*bilingualism can prevent dementia*”. In reality, what several studies (Alladi et al., 2013; Bialystok et al., 2007; Woumans et al., 2015) have found is something slightly but importantly different: bilingualism can delay the onset of dementia by ca. 4 years, an effect larger than that of any currently available drugs. This does not mean, alas, that bilinguals never get dementia. But it does mean that they tend to get it later. The same is true for many so-called “protective factors”, such as physical exercise or a balanced diet. They cannot prevent diseases: if they could, they would offer us the key to immortality. But they can lower the risk of certain illnesses and, if a disease occurs, delay its onset.

Furthermore, dementia is not a unitary disease entity but an umbrella term used for different types of cognitive impairment, caused by different pathologies and characterised clinically by different age of onset, natural history and symptoms. Not all forms of dementia seem to be equally influenced by bilingualism. The largest effect has been reported in Frontotemporal Dementia (FTD, sometimes referred to as Pick’s Disease), the smallest in Dementia with Lewy Bodies (DLB), with Alzheimer’s Disease (AD), the most common cause of dementia, in between (Alladi et al., 2013). The typically younger age of onset of FTD patients means that studies, which only include participants over a certain age threshold (Zahodne et al., 2014) are likely to miss some patients with an early dementia onset in whom the bilingualism effect is strongest.

(4) Either chicken or egg

The shift in emphasis from early to late bilingualism and indeed to language learning and its cognitive effects can help in controlling some confounding variables: rather than looking at different communities with their specific ethnic and cultural background and lifestyle, we can study individuals coming from the same community, some of whom learn other languages while others don’t. However, this advantage comes with a new methodological problem: can it be that people who grow up monolingually but later learn other languages are in some way different from those who remain monolingual? In other words, does learning languages lead to cognitive benefits or do better cognitive functions lead to language learning. This question, referred to in science as “*reverse causality*” and in every-day life as the “*chicken and egg problem*” is one of the greatest challenges in the field. One of the ways of addressing it is to examine people at baseline, before they start learning a foreign language and then, years later, after they have mastered it. This obviously would require many years, so we will need to wait for the results for quite a while. A possible shortcut is to examine first and last year language students and compare them to those

studying at other faculties (Vega-Mendoza et al., 2015). Another shortcut, if one is lucky enough to be able to obtain information about childhood cognitive abilities of the participants, is to compare the childhood performance with that of same people many decades later (Bak, Nissan, et al., 2014). In both cases the results demonstrate effects of language learning, which cannot be reduced to those in baseline cognitive performance.

However, is this really an either/or question at all? If we discover that some aspects of personality, cognition or social background predict whether someone is more or less likely to learn another language, does it automatically mean that learning a language itself has no cognitive effects? Like many other methodological issues discussed in this paper, this question is not unique to bilingualism. Let us take for example health effects of physical exercise and balanced diet, or at the other end of the spectrum, smoking and alcohol abuse. If we find out that some of these behaviours are associated with specific genetic or environmental factors, does it mean that they have themselves no influence on health? If someone's drinking behaviour is due to a certain gene or upbringing, does it mean that alcohol has no effect on his/her brain and liver? What we have here is obviously not a simple causality but an interaction, in which different biological, psychological and social factors lead to specific behaviours and those behaviours influence in turn physical and mental state of the individuals. It is highly likely that bilingualism and cognitive functions influence each other in both directions.

(5) Bilingualism, bilingualism and nothing but bilingualism

The cognitive effects of bilingualism are not a surprising anomaly; they are in line with the converging evidence for beneficial effects of mental activity on cognitive functions, often associated with the concept of "*cognitive reserve*" (Stern, 2002). Clearly, being an active bilingual or learning new languages are not the only methods of cognitive stimulation. There is emerging evidence for an effect of practising music (Bialystok & DePape, 2009; Schroeder, Marian, Shook, & Bartolotti, 2015) or learning new demanding skills such as digital photography (Park et al., 2014). Complex occupations have also been linked to a better cognitive performance in old age (Andel, Kåreholt, Parker, Thorslund, & Gatz, 2007; Andel, Silverstein, & Kåreholt, 2014; Smart, Gow, & Deary, 2014; Valian, 2015).

I am not aware of any study claiming that bilingualism is the **only** relevant factor explaining its results. On the contrary, many authors have warned explicitly against such an interpretational shortcut: "*Bilingualism should not be misunderstood as a 'cognitive panacea'. It is only one of many factors influencing cognitive functions and dementia and its influence can be either strengthened or weakened by other variables, be it genetic or environmental*" (Bak & Alladi, 2014). It is to be expected that many other activities contributing to a better cognitive performance will be identified in future. Beneficial effects of bilingualism are not made any less valid by evidence showing positive effects of other activities: there is fortunately more than one path to cognitive reserve.

3. Bilingualism and the "replication crisis"

Ironically, the most passionate arguments for the uniqueness of bilingualism are coming at the moment from the most ardent critics of the bilingual advantage. Reading some of their comments one could get an impression that bilingualism research has been struck by an exceptional amount of controversy, bias and conflicting evidence. Much of this impression is generated by selective reading of the available literature, focusing almost exclusively on the null results regarding bilingualism and leaving unnoticed any other

findings. A good example of this tendency is a recent study of dementia which found neither bilingualism nor education effects (Lawton, Gasquoine, & Weimer, 2014). A commentary to this paper (Fuller-Thomson, in press) stresses already in its title that the evidence presented in this study “*contradicts the hypothesis that bilingualism delays dementia onset*” and does not discuss the equally interesting and relevant null finding regarding education. However, with equal justification the same commentary could also be entitled “*Emerging evidence against an influence of education on the age of onset of dementia*” (Bak & Alladi, 2015). For some reasons yet to be studied, the notion that bilingualism might influence cognitive functions seems to encounter fervent opposition while hardly anybody objects to a comparable influence of education, another factor associated with a substantial amount of conflicting evidence (Bak & Alladi, 2015).

Indeed, the problems facing bilingualism research today are a reflection of a much broader debate in modern science, centred on issues such as “*publication bias*”, “*decline effect*” and “*replication crisis*”. Most of them are not new. Conflicting evidence and theoretical debates have accompanied science since its very infancy: indeed, it would be hardly possible to imagine science without them. The question of publication bias has been discussed for over 50 years, since Stirling’s seminal observation that out of 298 papers published in leading psychological journals, 286 confirmed the original hypothesis (Sterling, 1959). He argued that this is likely to have resulted from a selective publication practice with a bias towards confirmatory results and observed a similar trend across natural and social sciences of his time. Indeed, subsequent large studies have confirmed the presence of a pronounced publication bias in medical sciences (Easterbrook, Gopalan, Berlin, & Matthews, 1991). Also the decline effect is well known and documented and explains how initially strong results of all kinds tend to diminish over time (de Bruin & Della Sala, 2015). Likewise, the examples of exaggerations in the presentation of scientific findings discussed in the previous sections are certainly not isolated cases. In medicine and particularly in genetics almost every discovery is hailed as a “*breakthrough*” (or, since this word has already been devalued through frequent use, “*major breakthrough*”). If only a part of this were true, we would be living by now in a world free of diseases.

Tellingly, the first observation of the publication bias came from a psychologist (Sterling, 1959) and the biggest initiative to replicate research results has been conducted recently by a big collaborative team of psychologists (Open Science Collaboration, 2015). This does not necessarily mean that psychology is more affected by bias and non-replication than other disciplines; it could be that psychologists are more aware of these problems than many others. And within the field of psychology and cognitive science, bilingualism researchers seem to be particularly aware of methodological problems and constraints surrounding their work (Bak, 2016; Titone & Baum, 2014; Valian, 2015). However, many areas of cognitive neuroscience are characterised by deep and fundamental disagreements. An example could be the field of “*embodied cognition*”: the main debate there is not just about correctness of certain datasets but about the very nature of how human brain is organised (Bak, 2013b; Bak & Chandran, 2012). So far, the only attempt to explain theoretically why language learning should be the only mental activity which has no influence on cognitive functions, has been the assumption that speaking one language also required cognitive control (Paap & Greenberg, 2013). While this is undoubtedly true, this argument does not take into account what in medicine would be referred to as the “*dose-response*” curve: suppressing an occasional inappropriate expression is not quite the same as having to choose between two different lexical entries for every single uttered word (Bak, 2016). And this does not even touch upon the differences between languages going beyond the single word level, in phonology, morphology, syntax, semantics or pragmatics. Maybe it is time to move beyond questioning each other’s data to work on a broader theoretical model that could accommodate both types of results?

4. Cooking pasta in La Paz: why different studies produce different results

Having clarified some of the common misconceptions about bilingualism and cognition and having put bilingualism in the context of the “replication crisis” in modern science, let us move finally to the crucial question: why do different studies produce different results? The basic assumption that all experiments conducted in different places in the world and by different researchers should produce the same results depends critically on several prerequisites. It assumes the use of the same paradigms, same experimental material and its administration, same type of participants as well as the same analysis and interpretation of the results. Each of these steps can be critical. The question of **experimental settings** has received so far most attention. A classical study by Costa and colleagues (Costa, Hernández, Costa-Faidella, & Sebastián-Gallés, 2009) demonstrated how even small changes in the difficulty of an experimental paradigm make differences between mono- and bilingual subjects appear and disappear. Different ways of presenting the same stimuli can also influence the outcome: an elegant recent study demonstrated that a presumed age difference on multi-tasking disappeared completely when participants were tested with real objects (in this case cardboard props) rather than with a computer display: what was believed to be an ageing effect turned out to be due to lower familiarity with computer-based procedures in older participants (Kosowicz & MacPherson, in press). Even the time of testing can influence its results (Hasher, Zacks & May 1999).

The question of the selection of **participants**, based on the definitions of bilingualism, has entered the debate more recently. As already mentioned in previous sections, where we put the “*bilingualism threshold*” might well decide whether we find significant results or not. In epidemiological studies, such as those exploring the potential influence of bilingualism on the age of onset of dementia, the sampling frame and the choice of the outcome measures can play a crucial role. Furthermore, there are many differences between disciplines, in their methodological traditions as well as the type of data they are used to analyse: what might appear to be a relatively small effect to an experimental psycholinguist might be in fact a substantial effect at the level of whole populations examined by an epidemiologist (Bak, 2016).

Finally, different ways of **analysing the same data** can lead to different conclusions. Let us turn again to the already mentioned study of active and non-active bilinguals in the Hebrides (de Bruin et al., 2015): if we analyse the performance of active bilinguals versus monolinguals separately for switch and non-switch trials we find no significant difference between them, so we could simply conclude that nothing was found and end there. If, however, we compare the difference between switch and non-switch trials in each of the groups, the difference becomes significant. These subtle findings suggest that none of the groups is overall superior to the other: the bilinguals tend to be slower than monolinguals on non-switch and faster on switch trials. Although neither of these differences per se is significant, their opposite direction does produce a significant difference, in which active bilinguals have lower “*switching costs*”. This could reflect different processing strategies. Bilingual processing seems to be more geared towards changing stimuli, hence it produces only little difference between switch and non-switch conditions. Monolingual processing, in contrast, could be more geared towards the continuation of the same stimuli, making them faster in non-switch but slower in switch conditions.

However, even if we control for the experimental design, for the type of participants and the analysis of the data, the expectation for studies to replicate includes one more central assumption, which so far has hardly featured in the bilingualism debate. It is the assumption that **the same experiment should produce the same results independent of the environment in which it was conducted**. The serious problem posed by this assumption can be best illustrated by a simple physical experiment. Let us imagine that I want to determine the temperature at which water starts boiling. I conduct a series of experiments in my lab in Edinburgh and conclude that this temperature equals 100C. Keen to confirm the universality of my finding, I

contact colleagues in Amsterdam, New York, Los Angeles, Buenos Aires, Singapore and Tokyo and feel reassured to hear that all of them found exactly the same. And then, something very strange happens. A colleague from La Paz in Bolivia reports that repeated measurements have shown a significantly lower boiling temperature, well below 90C. At first it looks impossible to explain. Is it a measurement error? Is their water contaminated? Is their experimental setting flawed? The situation becomes clear only when more measurements arrive from places like Quito, Bogota, Addis Ababa or Lhasa. The boiling temperature of water depends on the altitude, a fact which will not become apparent if we confine our experiments to cities lying at the sea level.

This example illustrates several things, which are of crucial importance to the current bilingualism debate. Firstly, the fact that the same experiment does not replicate in every place does not have to be due to errors, incompetence, bad will, bias, let alone dishonesty of the researchers involved. It can reflect differences in the environment in which the study has been conducted. Secondly, and equally importantly, it does not matter how many measurements we can get from hundreds of coastal cities in the world, it does not invalidate one single measurement from La Paz. We will not get closer to the truth by repeating the same experiment in the same environment and counting the number of such replications: we have to compare the results across **different environments**. Accordingly, listing the results of a large number of studies will not help to understand the underlying phenomena unless they are representative for different environments. The currently so popular systematic reviews and meta-analyses can be in fact misleading, giving a false sense of “objectivity” (Bak, 2013a).

Finally, the discrepancy in results between different studies is not a curse but a blessing for the advancement of science. It can allow us to identify new factors, which would otherwise have gone unnoticed. It can help us to produce new theories, with a much stronger claim to universality than those based on a small sample of world’s countries and cultures. This is more easily said than done. The temptation of doing research in the easily available cohorts of undergraduate students at one’s own university is huge. I am far from criticising such research: it can be useful and valuable and I have been involved in several studies of this type myself (Bak, Vega-Mendoza, et al., 2014; Vega-Mendoza et al., 2015). But this should not be the **only** type of research being done. We need to go out and study populations across different countries, cultures and indeed continents (Bak & Alladi, 2015). If different environments influence physical observations (as in the example of boiling water above) as well as cognitive psychology findings (Henrich, Heine, & Norenzayan, 2010), why should we expect bilingualism to be an exception? I would not like to be misunderstood as an advocate of radical cultural relativism. It is very likely that many characteristics of human behaviour are universal. The seminal work of Paul Ekman on perception of emotions provides an impressive example of someone who set out to find differences and found similarities, leading to a truly universal theory (Ekman & Friesen, 1971; Ekman et al., 1987). But the only way we can find out whether something is universal is to do comparative research.

Until recently, most studies on bilingualism and cognition came from a relatively small number of countries, almost exclusively in the Western World. A good example of the problems connected with this lack of representativity is the intense debate about the role of **immigration** as a confounding variable in bilingualism research. Indeed, in almost all studies from the USA and several from Canada, bilingualism tended to be associated with an immigration background, making it difficult to disentangle the two phenomena (Fuller-Thomson & Kuh, 2014). To make things more complex, the association between bilingualism and immigration can also work the other way round, with the autochthonous population being originally bilingual and the immigrants (albeit often from different regions of the same country) being monolingual (as is the case in parts of the UK and Spain) (Bak, 2016). Given that both bilingualism and immigration might be associated with cognitive differences (Fuller-Thomson, Milaszewski, & Abdelmessih,

2013) both factors can either potentiate or cancel each other, explaining some superficially contradictory results (Bak, 2015). A good way forward in this case is to study societies in which bilingualism and immigration can occur independently of each other. Numerous studies taking this approach have shown beyond any reasonable doubt that the bilingual advantage is not always dependent on the immigration status (Alladi et al., 2013; Alladi et al., 2015; Bak, Nissan, et al., 2014; Ljungberg, Hansson, Andrés, Josefsson, & Nilsson, 2013; Woumans et al., 2015), although in other contexts immigration might constitute an important variable to be taken into account.

Another example, in which a comparison of results from different countries can be illuminating is the relationship between **education** and dementia, in which dementia is associated with lower educational level. This association has been reported not only from Europe and North America but also from Brazil (Cesar et al., 2015). However, in India bilingualism seems to have a stronger effect on dementia than education (Iyer et al., 2014) and the bilingual delay in the onset of dementia in illiterates is in fact larger than in the literate population (Alladi et al., 2013). In order to explain this discrepancy in findings, we need to examine the variables associated with education and literacy: in many countries, low education and/or illiteracy are associated with a whole range of negative variables, from unemployment and social deprivation to drug abuse and criminality. In India, in contrast, it is possible to find illiterates who are fully employed and well integrated into the society. We cannot simply expect to find the same associations of factors and causal relationships across countries and societies (Bak & Alladi, 2015). Moreover, it is important to bear in mind that in many societies bilingualism can be associated with higher as well as lower educational, professional and economic background, so its effects can be either potentiated or attenuated by these variables (Bak 2016).

Another potentially relevant factor, which can vary between countries and societies and which has only recently entered the bilingualism debate is the **context of use**. Bilingual behaviour might not have the same cognitive implications in places in which the majority of the population is bilingual (often with the same combination of languages) and used to switching between their languages on a daily basis (e.g. Hyderabad, Singapore or Barcelona) and in those with a monolingual majority in which language switching occurs to a much lesser degree and mainly in specific subgroups (e.g. Edinburgh, New York or Toronto). The context of language use plays an increasingly important role in current theoretical models of bilingualism and cognition (Green, 2011; Green & Abutalebi, 2013; Yang, Hartanto, & Yang, in press) and has been implicated as a possible explanation for conflicting results concerning possible effects of multilingualism (Freedman et al., 2014).

Finally, the general **attitude towards bilingualism** could also have its impact on bilingualism research. I agree entirely with the central role of "*Zeitgeist*" in understanding science (Klein, in this volume), but with two important caveats: firstly this should be applied to both types of results, those confirming and those questioning the bilingual advantage; secondly, an analysis of *Zeitgeist* has to examine both time and space. As hypothesised recently (Bak & Alladi, 2015; Bak, 2016) countries in which bilingualism is a natural part of every-day life and is officially recognised by the state, such as Canada, Belgium, Luxembourg or India, might have a tendency to report positive effects of bilingualism more often than countries in which bilingualism is a subject of continuing political controversy, such as USA, UK or Spain. Obviously this is only a tendency and not a rule; positive results have also been reported from the US (Gollan, Salmon, Montoya, & Galasko, 2011) and UK (Bak, Nissan, et al., 2014) and negative results from Canada (Yeung, John, Menec, & Tyas, 2014), so the question would merit a more thorough historical and sociocultural investigation. Are researchers in the officially bilingual countries more likely to extoll its virtues, while those in the "*ambivalent*" group might be more inclined to be critical and focus on null findings and negative effects? As much as we might strive as scientists to be unbiased and impartial, our way of thinking is bound to be

influenced by the society we live and work in. This might direct our attention to different phenomena and influence our expectations as well as our interpretation of the existing data. But these differences could be more profound than the interpretation of the data – they could affect the data as well. A social phenomenon, such as bilingualism, could have opposite effects on health and wellbeing depending on the positive or negative values attached to it by the state and society. Expectations can influence performance. Participants who believe that the very fact of them being able to speak a second language is a disadvantage might perform differently from those perceiving their bilingualism as an asset. So far, there has been very little dialogue between cognitive and social research on bilingualism – and yet, this might be one of the most promising avenues to advance our understanding of this topic.

Cooking pasta in La Paz is not the same as in Palermo; it can be annoying to find out that the well-rehearsed timing does not work and the final product does not have the expected taste and consistency. But experiencing it can lead to the realisation of the influence of altitude on basic physical processes. Doing bilingualism research in Toronto and San Francisco, Edinburgh and Barcelona, Hyderabad and Hong Kong might not be the same either. But in every place we can learn something new and putting together these bits of the puzzle can help us to get the larger picture. We should embrace the complexity of the results we are facing rather than try desperately to reduce them to an enticingly simple but ultimately misleading “yes” or “no” question (Bak, 2015; Woumans & Duyck, 2015).

Acknowledgements

First of all, I would like to thank the organisers of the CUNY interdisciplinary workshop on Bilingualism and Executive Functions, above all Irina Sekerina and Virginia Valian, for one of the most interesting and intellectually stimulating scientific meetings I have ever attended. This paper has been largely based on the talk I have presented at this conference. Furthermore, I am grateful to Blanca Ramirez-Ruiz for her critical review of my manuscript. Finally, I would to thank Anna Wolleb, whom I have met at the CUNY conference, for her kind invitation to La Paz. My visit there and the conversation with her about the very real problems of preparing pasta in La Paz have inspired the title of this paper and one of its central arguments.

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